Evaluation of Effects of the Kingston Ash Release on Benthic Invertebrate Communities

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Principle Study Question?

Do levels of ash-related constituents — particularly arsenic and selenium — within sediments in the Emory and Clinch Rivers pose sufficient risk to ecological receptors?

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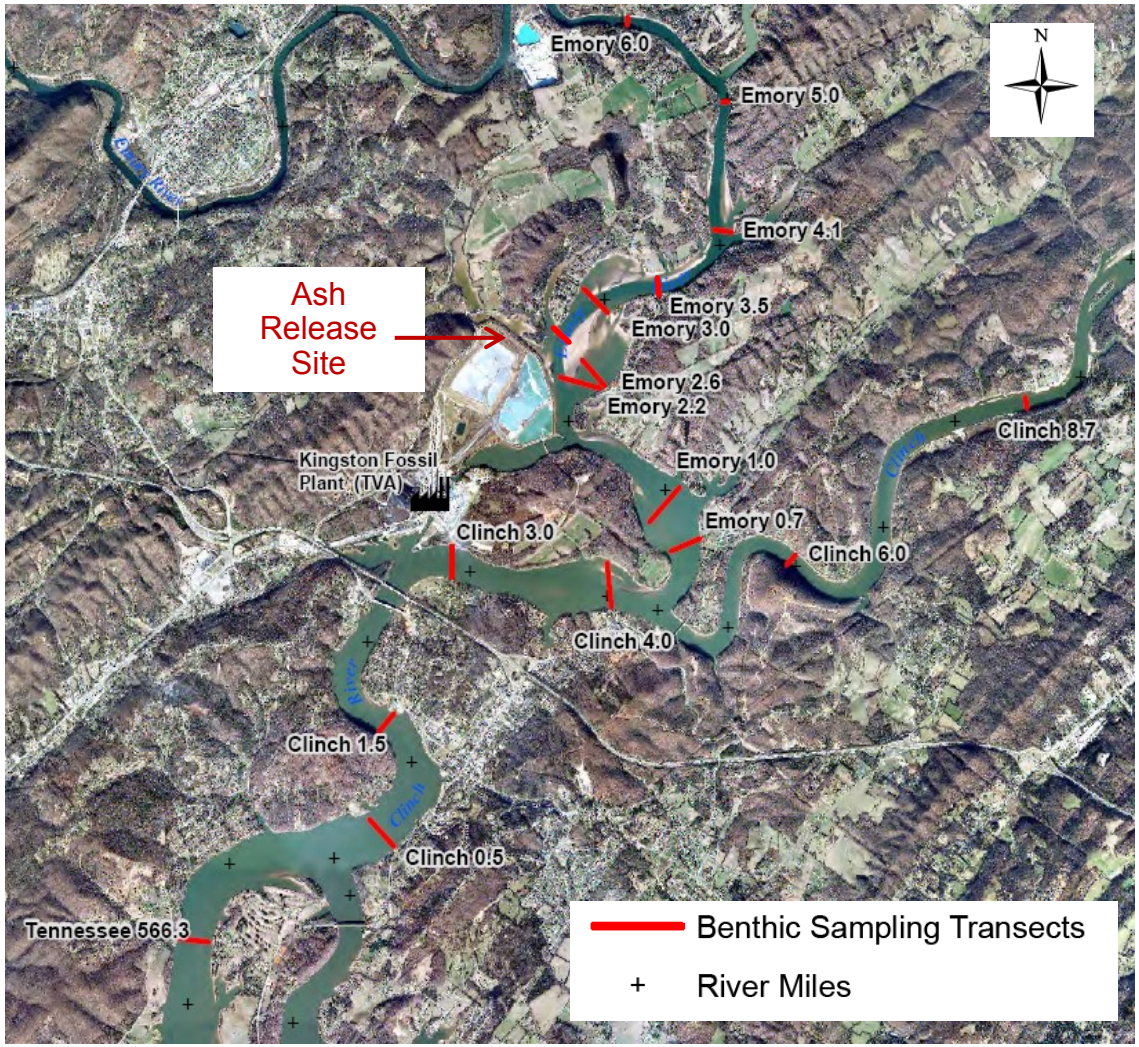
Methods

- Sampled up to 18 sites each year
- Ten equally-spaced Ponar grabs across width of the reservoir (i.e., transects)
- Grab samples washed through a 0.6 mm mesh screen and remaining content preserved
- Each sample analyzed in the laboratory for taxonomic identification and enumeration of benthic invertebrates.



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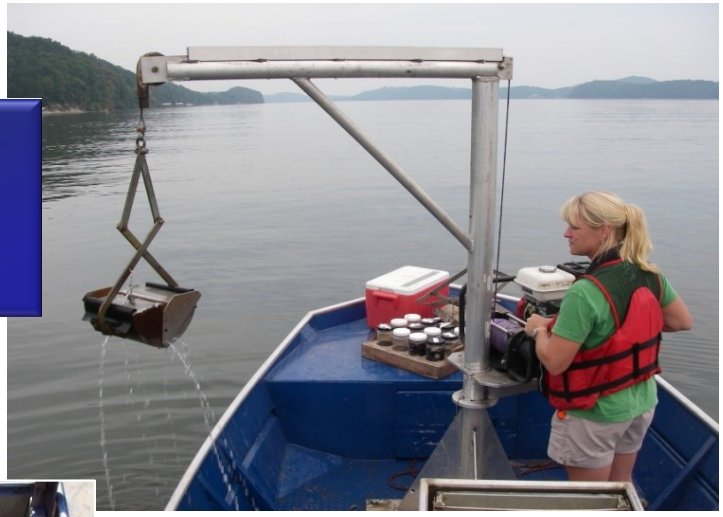
Ponar Sampling Method



Methods

Substrate Determination

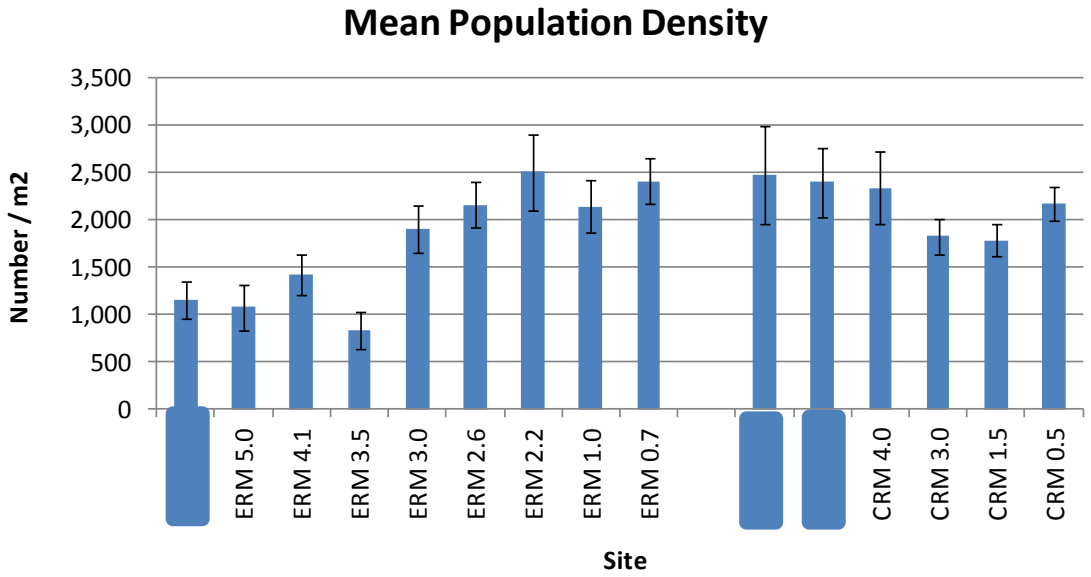
- Recorded water depth and substrate composition
- Visual assessment of substrate type and presence of coal fly ash.

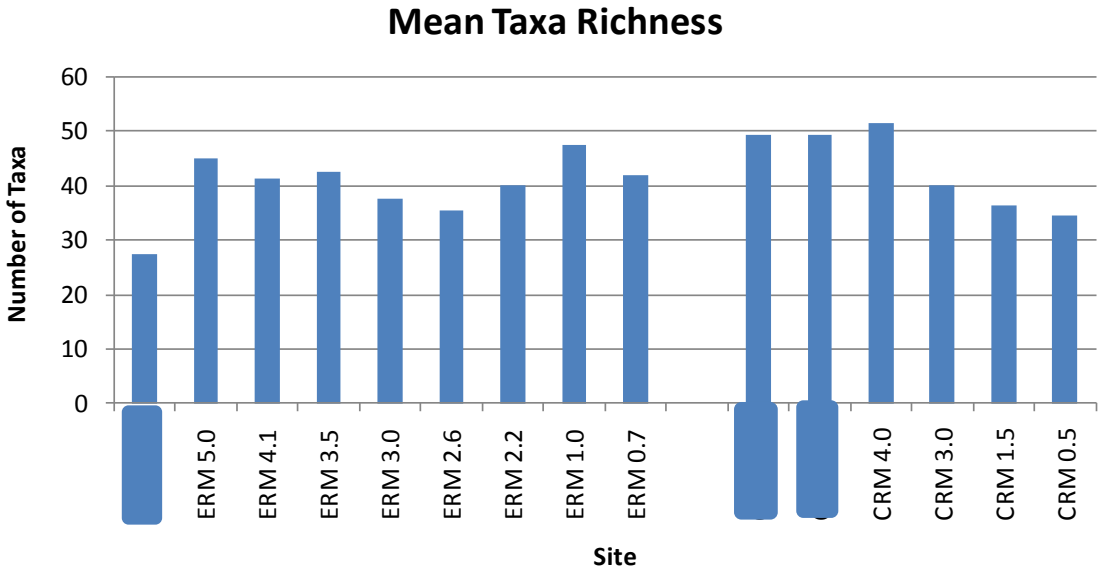
Co-located sediment samples collected in 2011 and 2012

- Analyzed for concentrations of target analytes, grain size distribution, and %Ash

Population Density and Taxa Richness

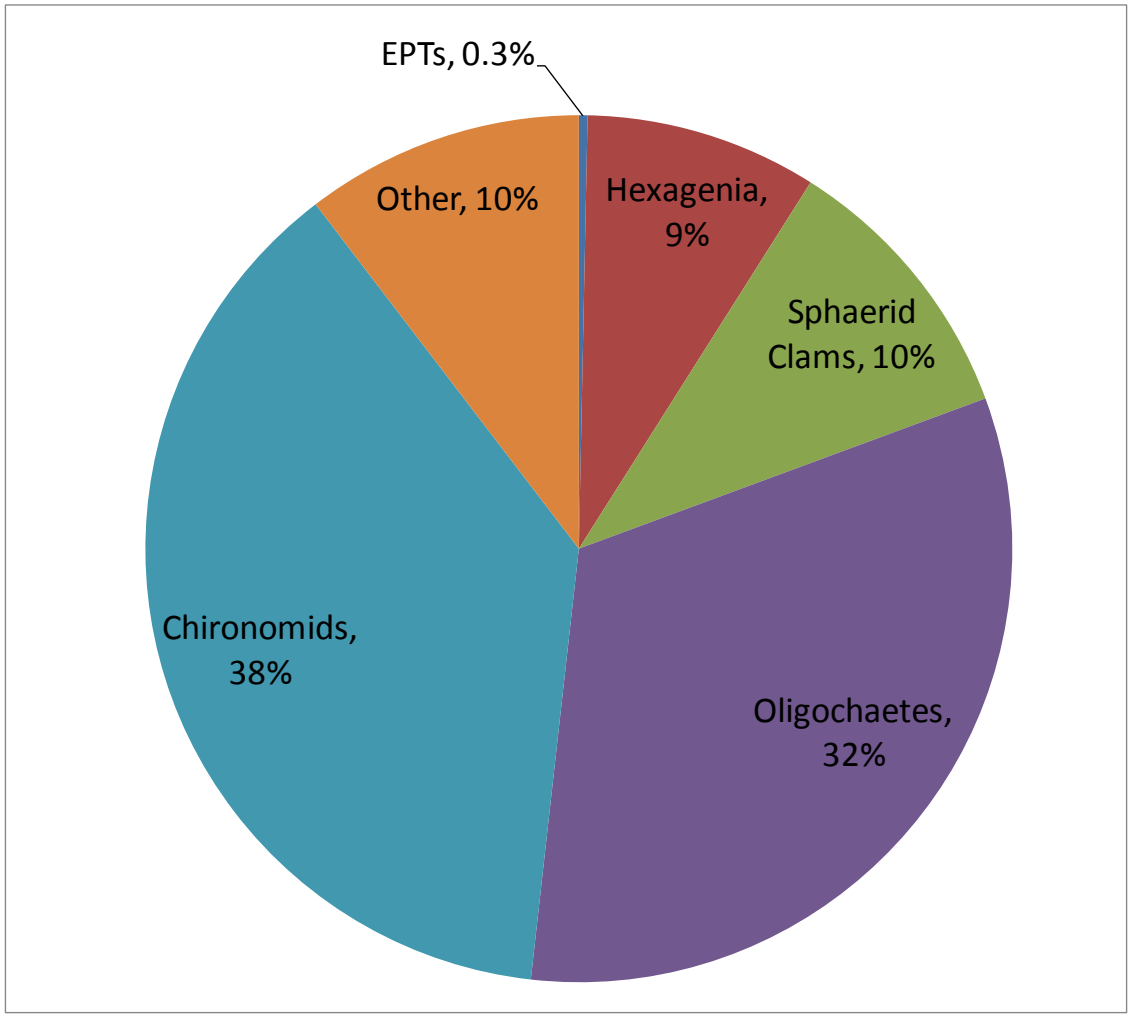
Benthic Community
2011 and 2012



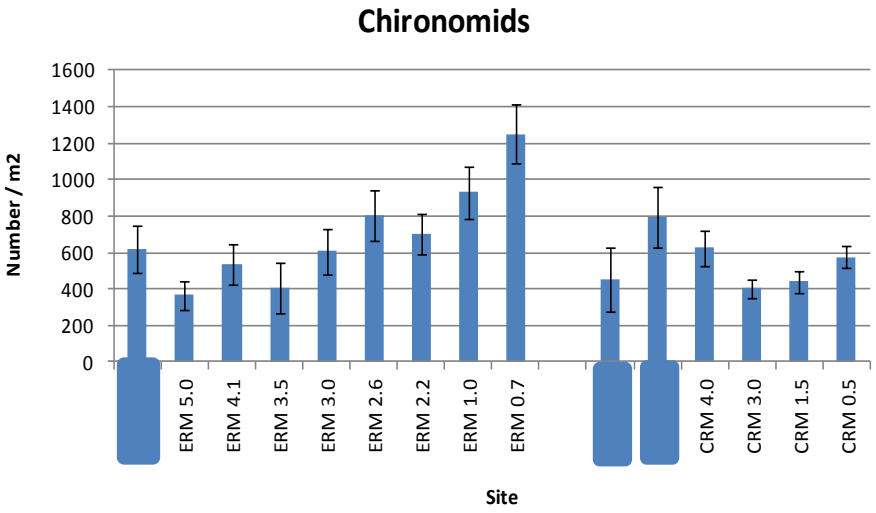


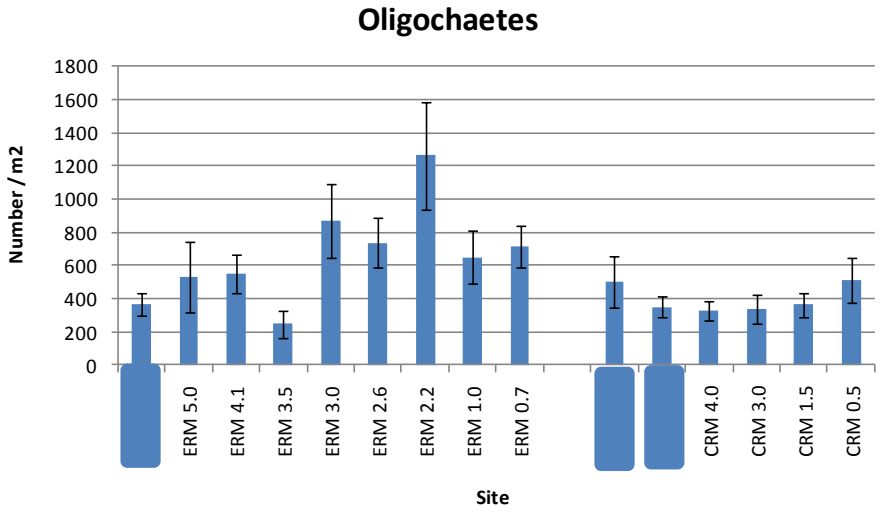
"Reference" Sites

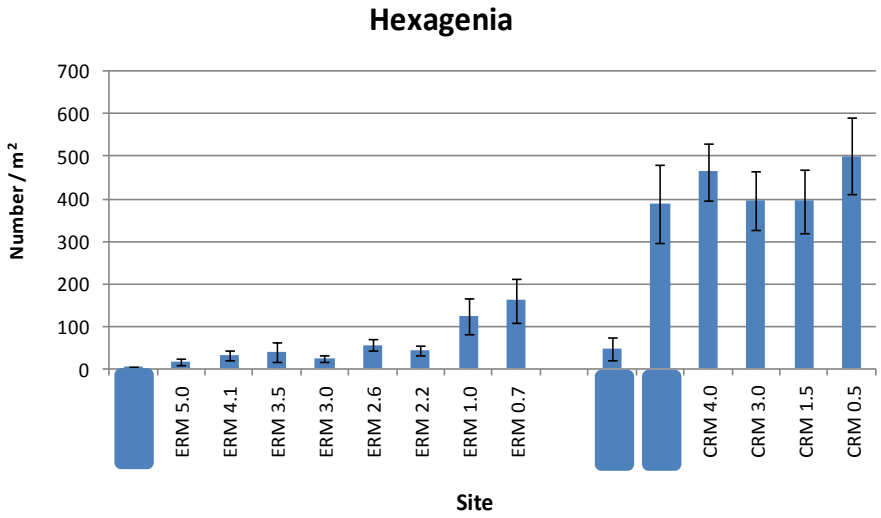
Summary of Benthic Invertebrate Composition

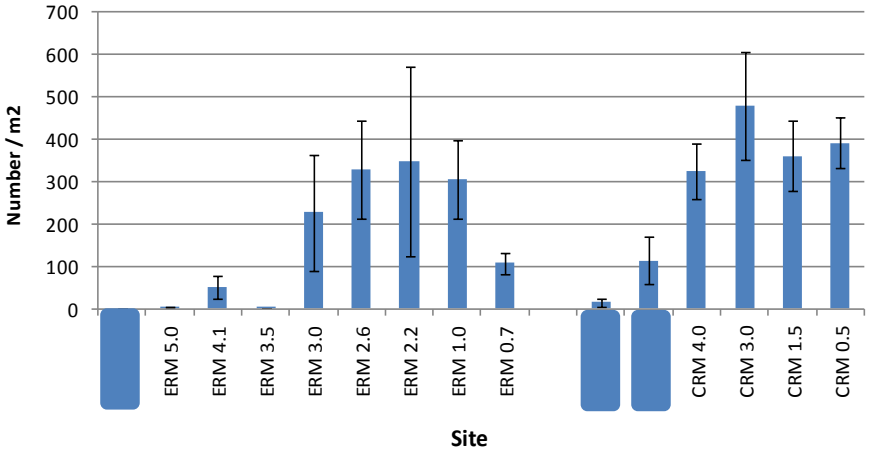


Mean Density of Dominant Taxa Groups 2011 - 2012





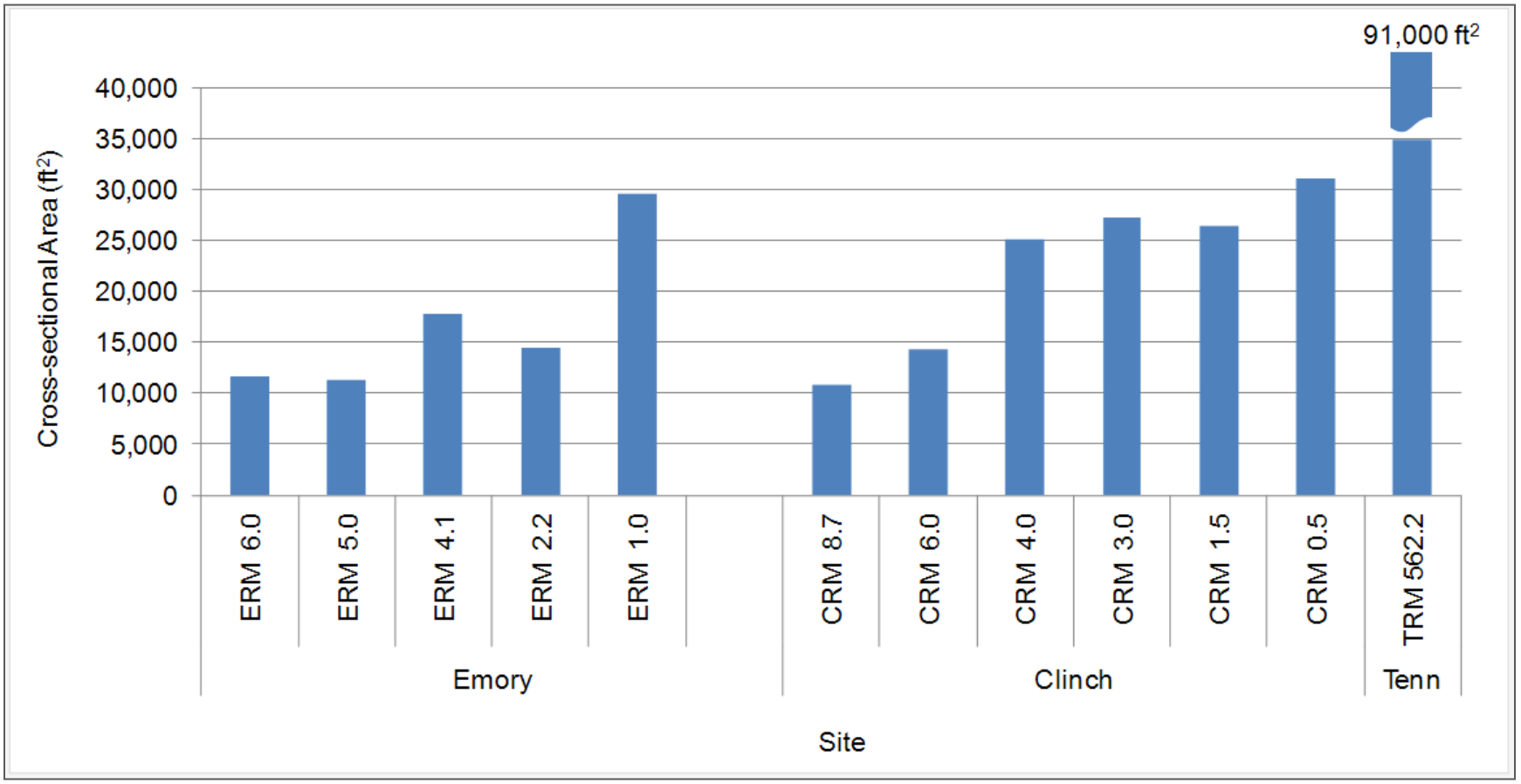




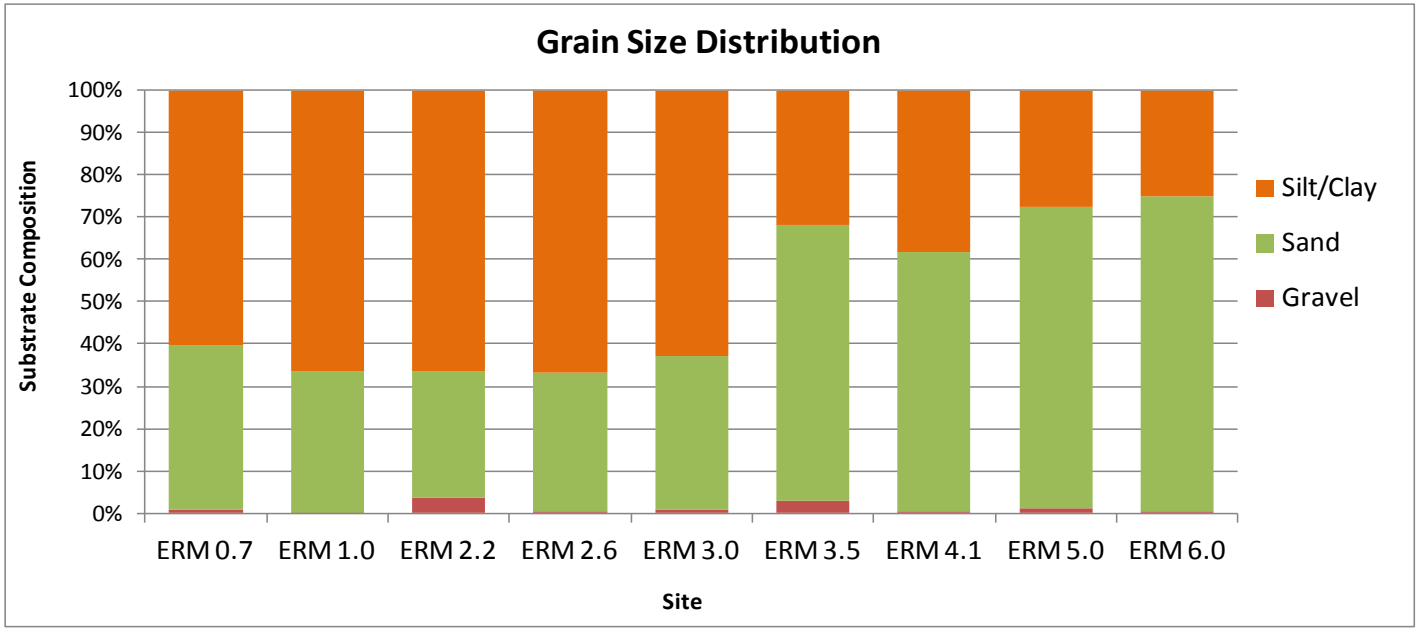
"Reference" Sites

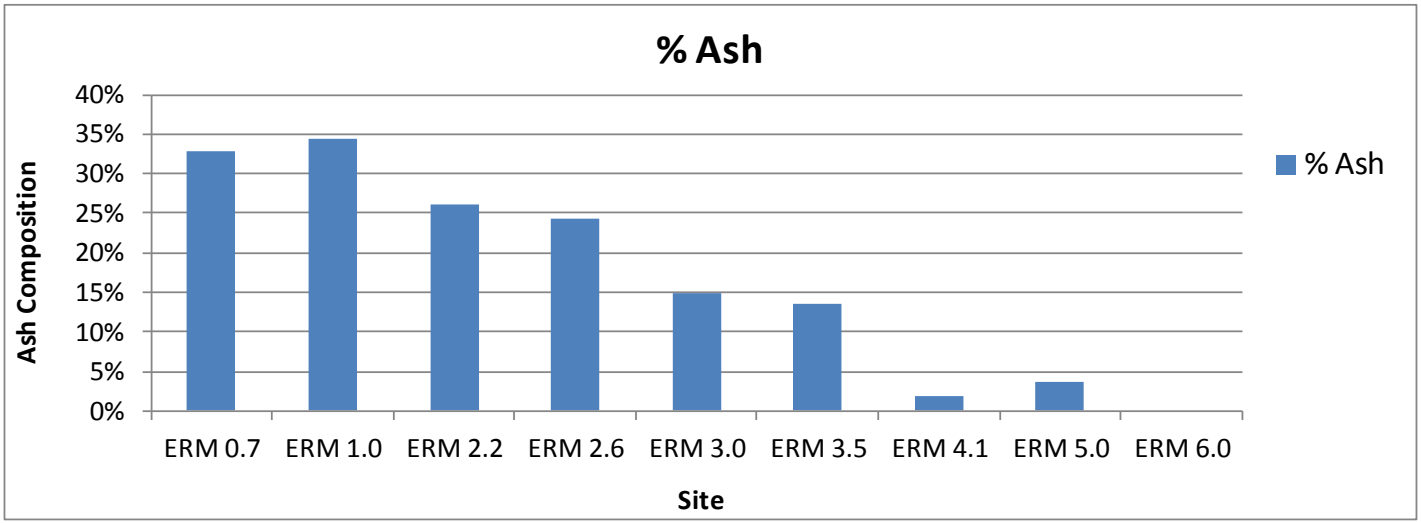
Mean Density (± SE)

Cross-sectional Area of Sampling Sites

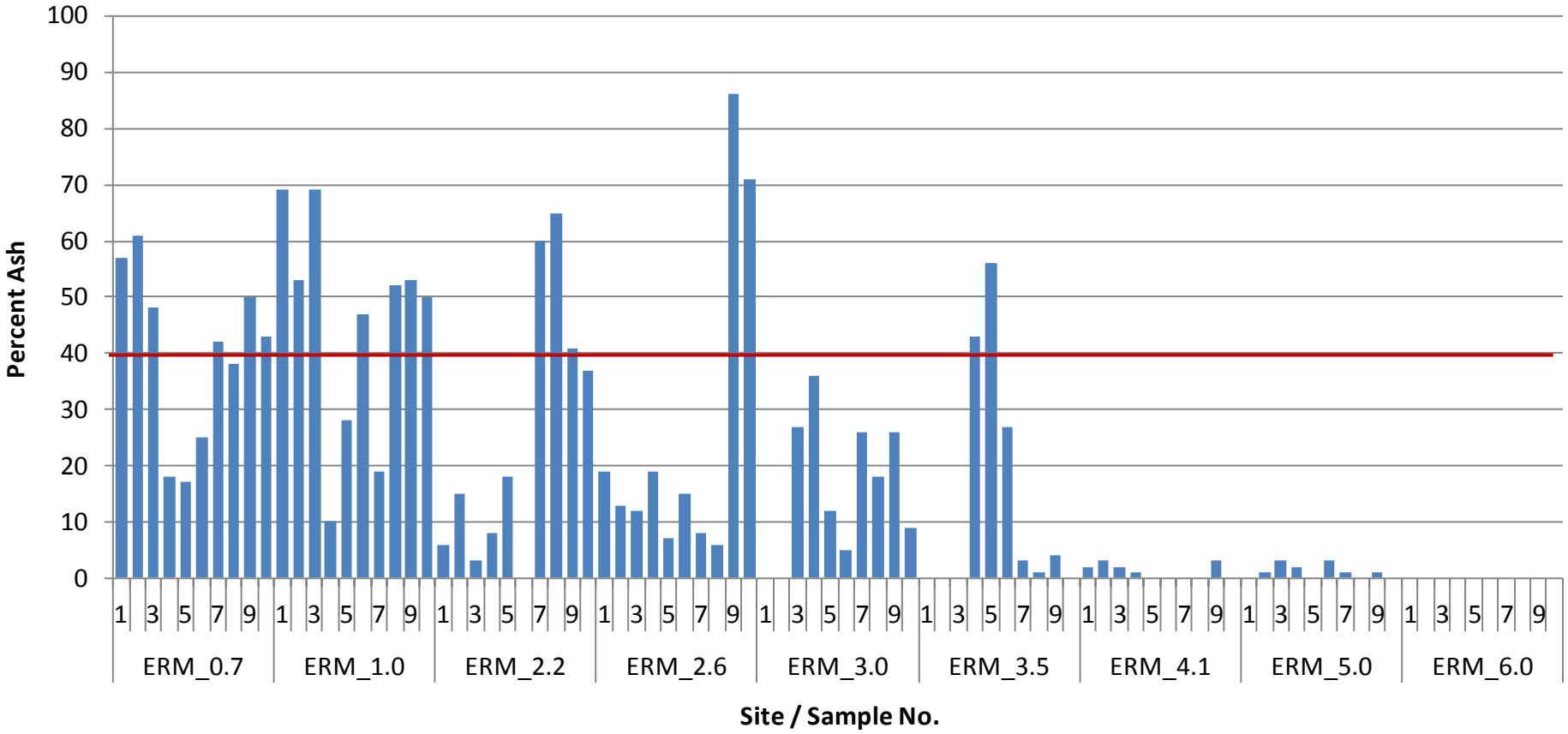


Composition of Substrate in Co-located Sediment Samples





Composition of Ash
Co-located Sediment Samples, 2012



Downstream ← Upstream

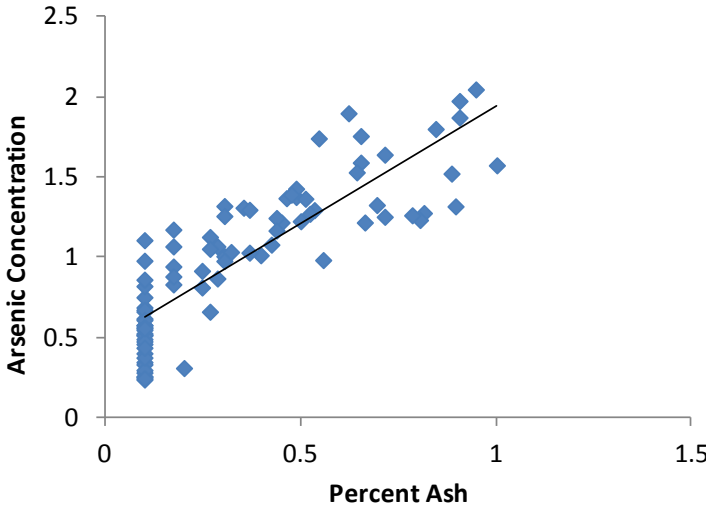
Relationship of %Ash to As and Se Concentrations

% Ash prediction of As concentrations:

r^2=0.7114, $p < 0.0001$

% Ash prediction of Se concentrations:

r^2=0.1966, $p < 0.0001$



Comparison of Physical/Chemical and Benthic Community Data

- Stepwise Regression
- Spearman Rank Correlation
- Ash related impacts on the invertebrate community appear limited, except for ERM 2.6.
- Several invertebrate measures (e.g. total density, taxa richness, chironomid density) had a significant inverse relationship with %Ash.

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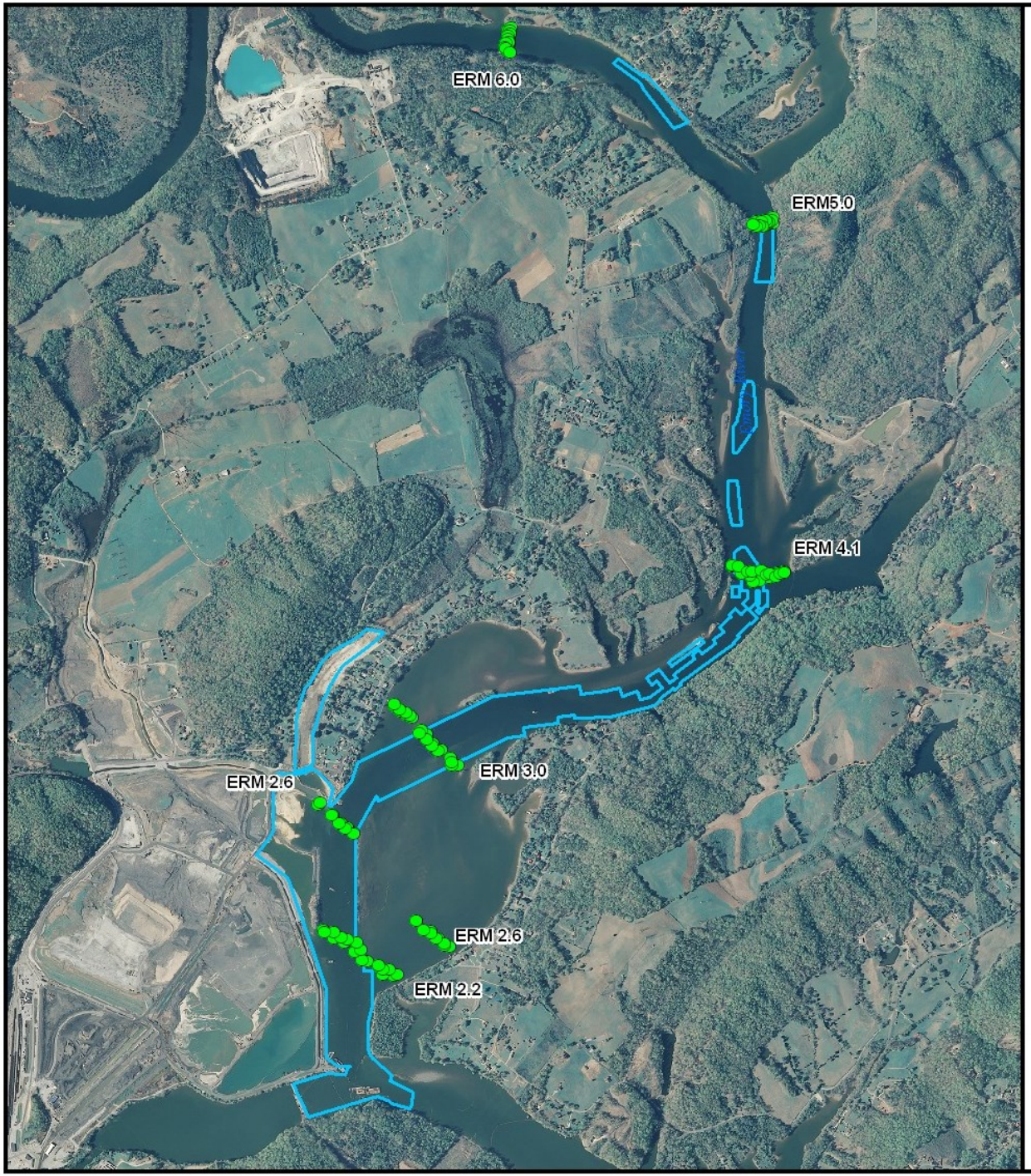


Kingston Ash Recovery

Benthic Community Waypoints

Benthic Community Waypoints

Phase 1 Dredge Area

N

0 2,000 4,000

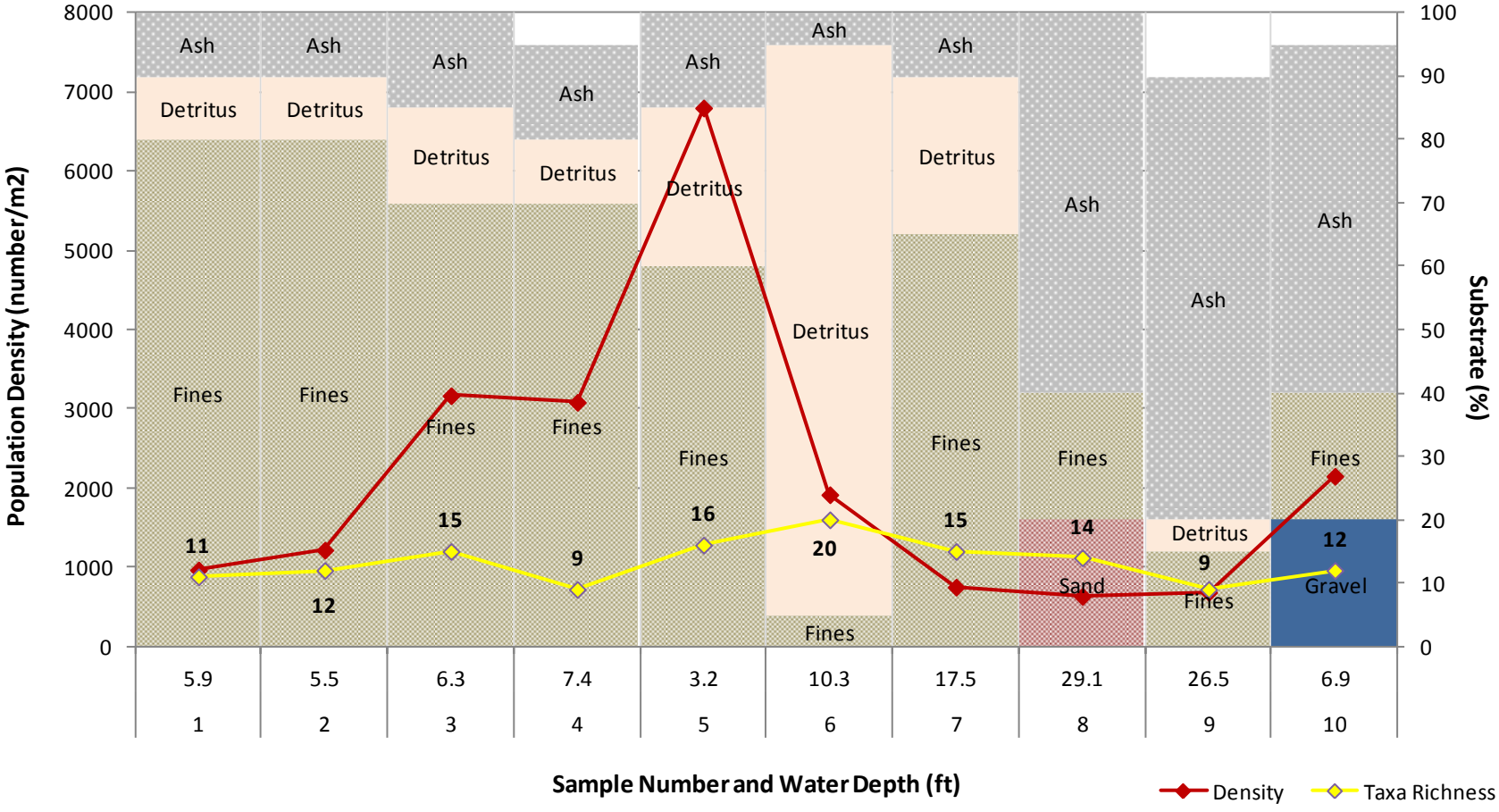
Feet

Photography Date:
04/11/2010

Map Compiled
07/27/2011

Tennessee Valley Authority
Geographic Information & Engineering

Population Density, Substrate, and Water Depth
Emory River Mile 2.6, December 2010



Summary

- Benthic invertebrates in the Emory River in the immediate area of the spill were undoubtedly impacted by the ash deposits and later dredging operations.
- Four years of results suggest limited ash-related impacts.
- Community composition typical of Tennessee River reservoirs with dominance of chironomids, oligochaetes, bivalves, and *Hexagenia.*
- While some differences may be attributed to residual ash in the river system, the majority of variation was due to substrate and habitat heterogeneity.

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QUESTIONS?